

HYDROGEN CYANIDE PRODUCTION IN NORTH AMERICAN AND AFRICAN POLYDESMOID MILLIPEDS¹

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A diversity of substances has been isolated from the defensive secretions of millipeds, including hydrogen cyanide, benzaldehyde, phenols, 1,4-benzoquinones, quinazolinones, and nitrogen-containing terpenes (references in Altman and Dittmer, 1973; Duffield *et al.*, 1974; Meinwald *et al.*, 1975; Smolanoff *et al.*, 1975; Wood, 1974; Wood *et al.*, 1975). Hydrogen cyanide, the first of these compounds identified (Guldensteeden-Egeling, 1882), has been reported from over a dozen European and New World species, all members of the suborder Polydesmida (Barbetta *et al.*, 1966; Blum and Woodring, 1962; Blum *et al.*, 1973; Casnati *et al.*, 1963; Davenport *et al.*, 1952; Duffield *et al.*, 1974; Eisner *et al.*, 1963; H. E. Eisner *et al.*, 1963; Hall *et al.*, 1969; Monteiro, 1961). We have demonstrated hydrogen cyanide production in four additional polydesmoid species, strengthening the view that cyanogenesis may be of widespread, if not general, occurrence within the suborder. Three of the species, *Apheloria trimaculata*, *A. kleinpeteri*, and *Pseudopolydesmus branneri*, stemmed from the U. S. A. (the first species was from Clifton Forge, Virginia; the other two from Roanoke, Virginia); the fourth species, *Astrodesmus laxus*, was from Africa (Mombasa, Kenya). The animals were tested for cyanogenesis by manipulating them and gently squeezing them, while at the same time holding beside their bodies strips of filter paper impregnated with benzidine acetate-copper acetate reagent (Feigl, 1966). In all instances the papers turned blue, indicating release of hydrogen cyanide vapor from their glands. In single individuals of each of the North American species, cyanogenetic output was assayed quantitatively (see accompanying table), using the technique previously developed in our laboratories (H. E. Eisner *et al.*, 1967).

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TABLE
CYANOGENETIC OUTPUT OF MILLIPEDS

Species	Sex and Body Weight of individual	Cyanogenetic Output ($\mu\text{g}/\text{individual}$)
<i>Apheloria trimaculata</i>	♂ (769 mg)	16
<i>A. kleinpeteri</i>	♀ (1053 mg)	27
<i>Pseudopolydesmus branneri</i>	♂ (199 mg)	32

Cyanogenesis in polydesmoid millipeds involves simultaneous release of hydrogen cyanide and aldehyde from stored cyanohydrin (Eisner *et al.*, 1963). The aldehyde has been shown to be benzaldehyde in several species (Barbetta *et al.*, 1966; Blum *et al.*, 1973; Blum and Woodring, 1962; Casnati *et al.*, 1963; Duffield *et al.*, 1974; H. E. Eisner *et al.*, 1963; Monteiro, 1961; Weatherston and Gardiner, 1973). We made no effort to isolate the aldehyde in the three North American species, but found evidence that *Astrodesmus latus* produces benzaldehyde. Gas-liquid chromatography of a sample of secretion from this milliped, obtained by wiping the discharged fluid from the gland openings with pieces of filter paper, showed a peak of identical retention time to that of authentic benzaldehyde. Some polydesmoid millipeds have ancillary phenolic components in their secretion (Blum *et al.*, 1973; Duffield *et al.*, 1974; Monteiro, 1961). We did not attempt to isolate such components in our species, although the secretion of *Pseudopolydesmus branneri* had a phenolic odor.

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